

PRELIMINARY REPORT ON ARGULIDAE FOUND IN JAPAN

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ONE PLATE

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In this paper I propose to describe briefly the species of Argulidæ found in Japan. There are five species including two freshwater and three marine forms, of which one is new to science. Detailed statements on them are all reserved for a future paper.

1 *Argulus japonicus* Thiele, 1900¹

(Pl. 21, figs. 1, 2)

1900: *A. japonicus* J. Thiele, Zool. Anz., vol. 23, p. 48.

1902: *A. japonicus* Ch. B. Wilson, Proc. U. S. Nat. Mus., vol. 25, p. 727.

1904: *A. japonicus* J. Thiele, Mitteilungen aus dem Zoologischen Museum zu Berlin, Bd. 2, Hft. 4.

1913: K. Nakazawa, Journal of the Imperial Fisheries Institute, vol. 9, No. 7. (in Japanese).

Body length of female up to 8·9 mm, averaging 4·6 mm; male smaller, about 3/4 of female. Colour of living female dark green on the whole except thorax showing through yellowish eggs contained in oviduct and ovary, and violet-brown pigment spots on the dorsal wall of oviduct. Carapace round to elliptical, with considerable individual variation; lateral lobes covering barely third legs in some individuals, and reaching well beyond the last thoracic segment in others; antero-lateral sinus present but not conspicuous. Dorsal ribs forked.

¹ In a personal letter to Prof. T. Komai, Dr. Ch. B. Wilson states that he has examined some specimens of *Argulus* collected from goldfish in Tokyo which show difference in several features from Thiele's original description of *A. japonicus*. It seems to me, however, that all the differences alleged by him are nothing but individual or rather seasonal variations. The materials of this species in my hand which have been obtained in various seasons and from various localities show a fairly wide range of variation in all respects he mentions.

Anterior respiratory area roundish triangular, posterior much larger and reniform. First segment of antennule with a large spine at postero-median corner, second with a spine on each anterior and posterior margin, terminal portion barely reaching beyond the hook. First segment of antenna armed with a spine on posterior edge. Post-antennal spines stout; sting long.

Chitinous ribs of sucker about fifty in number, each consisting of one long basal and about six (in adult) round segments.

Maxilla moderate-sized; provided with three large spines on posterior margin, two setae at the centre of posterior margin of rounded scaled area. Anterior pair of postmaxillary spines larger than posterior.

Tip of flagellum in anterior two pairs of legs reaches almost the base of coxa. Middle segment of endopodite of first leg half as long as terminal. Protopodites of three anterior pairs of legs without setae except one on posterior margin of coxa; posterior margin of last pair with many plumose setae.

Coxa of second leg of male with two papillated protuberances on posterior margin and a spine near the base of anterior margin (fig. 2). Precoxa of third leg with a forward papillated process on antero-ventral side, and a papillated area on dorsal side. Semen capsule surrounded by three folds, with two small papillated protuberances in front of aperture and one at base of inner fold; posterior margin distal to the capsule with a few plumose setae. Peg furnished with a thumb-like process at the base of ventral side, papillated dorsally, and armed along outer edge with chitinous thickenings which end in a very short spine.

Abdomen elliptical, slightly longer in male, attached to thorax by narrow basal portion; posterior lobes with bluntly rounded tips; anal sinus cut almost to centre: caudal furcae basal.

Commonest in Japan, found practically in any season on goldfish and also on *Cyprinus carpio* (Linné), *Carassius carassius* (Linné) and many other freshwater fishes.

2 *Argulus coregoni* Thorell, 1865

(Pl. 21, fig. 3)

- 1865: *A. coregoni* Thorell, Öfv. Ak. Forh., vol. 21.
- 1871: *A. phoxini* Leydig, Arch. Naturg., vol. 37, 1.
- 1875: *A. coregoni* Claus, Z. Wiss. Zool., vol. 25.
- 1900: *A. coregoni* Nettovich, Arb. Int. Wien, vol. 13.
- 1902: *A. coregoni* and *A. phoxini*, Ch. B. Wilson, Proc. U. S. Nat. Mus., vol. 25.
- 1904: *A. coregoni* J. Thiele, Mitteilungen aus dem Zoologischen Museum zu Berlin, Bd. 2, Hft. 4.

I refer to this European species with some doubt a male specimen obtained at Ōtsu from *Acheilognathus moriokae* Jordan et Thompson and mounted in balsam. Compound eyes and nauplius eye black, testes dotted conspicuously with black pigment on dorsal and ventral sides. Carapace roundish, antero-lateral sinus present, but very shallow; posterior sinus about 2/7 of carapace, tips of lateral lobes bluntly pointed, approaching each other and reaching almost the base of abdomen, partly covering last legs. All legs well beyond margin of carapace. Dorsal ribs forked.

Anterior respiratory area roundish, more angular than in *A. japonicus*; posterior somewhat reniform. Antennule and antenna much like in the preceding species. Post-antennal spines comparatively short. Sting long. Suckers rather small and rather widely separated; chitinous ribs about sixty in number, consisting each of one longer and four shorter segments. Maxilla moderate-sized; posterior margin of basal segment armed with three large spines, innermost of which being very slightly shorter than the rest. Scaled area oval, with two setae at the middle of posterior border. Posterior postmaxillary spine smaller than anterior. Tip of flagellum in two anterior pairs of legs reaches almost the base of coxa. Posterior margins of coxa and basis of first leg fringed with plumose setae; second and terminal segments of endopodite equal in length. Coxa of second leg provided with two papillated protuberances on postero-ventral edge, of which the proximal one bears a very long finger-like non-papillated process on dorsal side. A few plumose setae on posterior margin of basis. Semen capsule with a small papillated thickening in front of aperture; inner fold with two pailliated areas at base, one behind the other; outer fold fairly thickened and slightly papillated at base. A narrow papillated area present on dorsal side of preoxa and a large one on ventral side of coxa, whose antero-distal and postero-proximal edges project slightly. Basis slightly papillated dorsally with several plumose setae on posterior margin; antero-proximal corner of basis and base of exopodite fairly prominent. Posterior margin of protopodite of last pair fringed with many plumose setae. Peg with two additional blunt spines on anterior margin somewhat inward from tip and a thumb-like process at base on ventral side. Postero-proximal edge of basis slightly projecting.

Abdomen very large, much longer than wide, about 1/2.2 of the rest of body, attached to thorax by very short narrow base; posterior lobes with nearly parallel sides, narrowed gradually toward pointed tips; anal sinus cut almost to centre; caudal furcae basal.

Large testes with dark pigment spots showing through on both sides.

Remarks:—This specimen resembles *A. coregoni* very closely, but differs from it in smaller size of body, fewer segments of chitinous ribs of sucker, and in abdominal lobes being with nearly parallel margins. Of these however, the first two are probably due to differences in age, and the last one is an artifact. I refer, therefore, the present specimen to *A. coregoni* provisionally. The number of chitinous ribs of sucker in European specimens has never been counted. When this is done the identity of this specimen may become clear.

At all events, it is very interesting from viewpoint of distribution that, besides *A. japonicus* which resembles the European *A. foliaceus*, a form much like *A. coregoni* is found here in Japan also.

Total length 4.1 mm.

3. *Argulus scutiformis* Thiele, 1900

(Pl. 21, fig. 4)

- 1900: *A. scutiformis* J. Thiele, Zool. Anz., vol. 23.
- 1902: *A. scutiformis* Ch. B. Wilson, Proc. U. S. Nat. Mus., vol. 25.
- 1902: *A. scutiformis* G. B. Howes, Proc. Linn. Soc. London, 1901/2.
- 1904: *A. scutiformis* J. Thiele, Mitteilungen aus dem Zoologischen Museum zu Berlin, Bd. 2, Hft. 4.

This species is the largest of all known argulids, and reaches more than 30 mm, averaging about 22 mm in female, the male being about 1/1.7 of female. A lot of specimens collected from external surface of *Mola mola* (Linné) at Misaki and about fifteen from unrecorded host in Hokkaido have been examined. Colour of preserved specimens dark yellowish-brown, mostly unpigmented, exceptionally heavily pigmented in violet-brown.

Carapace well developed and oval, antero-lateral sinus deep and very conspicuous; cephalic area rather broad, projecting prominently. Lateral lobes rounded posteriorly overlapping each other and covering all appendages, and practically whole abdomen in female, but only anterior half of abdomen in male. Grooves and areas on carapace are all very conspicuous. Dorsal ribs not forked. Compound eyes and nauplius eye very obscure. Anterior respiratory area oval, posterior large and reniform, fairly apart from the former; both areas not bordered by pigment.

First segment of antennule on its posterior margin with two enormous spines, of which outer one very slightly smaller; second segment with a large spine on each anterior and posterior margin; terminal

portion hardly extends beyond the hook. First segment of antenna armed with a large spine on posterior margin and a shorter process at postero-lateral angle. Post-antennal spines very strong. Sting comparatively small.

Proboscis papillated at base; lower lip has a pair of small processes with finger-like tips at dorso-lateral angle at some distance below the constriction between lower lip and body of proboscis.

Sucker moderate-sized; chitinous ribs consist each of thirty to forty ring-shaped segments. Maxillae very stout, with a prominent oval pad-like scaled area on basal segment, besides three spines on posterior margin of the same segment, the outermost of which is very slightly smaller than the rest and lies fairly apart from these. Post-maxillary spines yellowish brown, posterior pair very minute. Lateral sides of last thoracic segment of female project and form reniform lamellae covering base of abdomen. Tips of swimming legs do not attain beyond margin of carapace; only first pair bear flagella which reach well beyond basal margin of coxa. Last segment of endopodite of first leg is slightly shorter than middle segment. In female, basis of legs are fringed with plumose setae, only on posterior margin in first leg, on both anterior and posterior margins in second and third legs, and only on posterior margin of the last leg. Coxa of three anterior pairs bare, but with a single seta in some cases; coxa in the last pair somewhat triangular, postero-distal corner projecting slightly, posterior margin fringed thickly with plumose setae.

In male, coxa of second leg with papillated prominence at the postero-proximal angle. In third leg, semen capsule opens somewhat more anteriorly than in the other species; anterior margin of basis forms a large protuberance divided into two conspicuous projections in the middle and with a knob on outer side, and a small process on inner edge; two hammer-shaped chitinous processes in front of aperture. Peg oval. Abdomen in female 1/4-1/4.5 as long as body and roundish, but slightly wider than long; projecting forwards beyond posterior margin of third thoracic segment, covering last legs completely; in male slightly longer. Anal sinus cut very slightly and narrow; caudal furcae basal. Testes very large, occupying the greater part of abdomen.

Remarks:—Although my specimens differ slightly from Thiele's description of *A. scutiformis* in the pattern and number of segments of chitinous ribs of the sucker, they agree with the latter in other morphological details, as well as in habitat.

4 *Argulus caecus* Wilson, 1922

(Pl. 21, fig. 5)

1922: *A. caecus* Ch. B. Wilson, Arkiv för Zoologi, Bd. 14, No. 10.

Five females collected from *Sphaeroides* spp. from various localities on the Pacific coast of Japan. Body somewhat smaller than in the preceding species, reaching 16 mm. Beautifully coloured while living; ground colour light blue marked with patterns of brown pigments as in *A. scutiformis*; compound eyes black-coloured and respiratory areas fringed with dark pigments. Preserved material whitish yellow, yellowish brown or somewhat greenish, with compound eyes faint or invisible. Compound eyes small, nauplius eye indistinct.

Carapace elliptical, longer than wide; cephalic area fairly prominent, longer than that of preceding species; antero-lateral sinus very conspicuous; anterior end of posterior sinus almost reaching centre of carapace; lateral lobes cover all appendages and main part of abdomen, with tips well rounded, overlapping or touching each other. All grooves on carapace very distinct; dorsal ribs not forked; thoracic area somewhat longer than that of *A. scutiformis*. Anterior respiratory area oval, posterior larger and piriform, slightly apart from the former.

First segment of antennule armed with two spines, of which the outer is much smaller; second segment with one spine on each anterior and posterior margin, with terminal portion not beyond the hook. First segment of antenna provided on posterior margin with a spine which is as large as the outer spine of first segment of antennule, and a process at distal end. Post-antennal spine fairly large. Proboscis with several pigment spots on surface and a pair of spines in front of mouth aperture.

Suckers comparatively small, chitinous ribs consist each of twenty to thirty ring-shaped segments, of which basal one is fairly larger. Pattern of scaled areas on maxillae much like in *A. scutiformis*, outer spine on posterior margin of basal segment smaller than inner spines. Post-maxillary spines colourless, posterior pair very small. Flagellum present only on first leg, with the tip reaching scarcely the base of coxa. First leg usually with a seta on posterior margin of coxa; terminal segment of endopodite about half as long as second. Basis of three anterior legs with plumose setae on posterior margin. Coxa of last pair fringed with plumose setae on posterior margin and with posterior distal edge projecting slightly.

Abdomen 1/3 as long as body, approximately shield-shaped with

nearly parallel sides, as long as wide or slightly longer than wide; tips of posterior lobes pointed or blunt; anal sinus slit-like, reaching 1/3-1/4 the length of abdomen; caudal furcae basal.

Remarks:—In Wilson's type specimen, the abdominal lobes have rounded tips, while they are rather acuminate in my specimens. He gives no description of the spine on the posterior margin of the basal segment of the antenna. His type has no pigment. In spite of these differences, my specimens may be safely identified as *A. caecus*, for they agree very well in general body shape, in proportion of body parts and in other details.

5 *Argulus onodai*, n. sp.²

(Pl. 21, figs. 6, 7)

A female taken by Prof. K. Onoda in August 1934 at Katu-ura, Kii from body surface of *Spheroides alboplumbeus* (Richardson). Body 8.4 mm, colour yellowish brown without any pigment. Compound eyes rather small and black, nauplius eye indistinct.

Carapace round, slightly longer than wide; antero-lateral sinus deep and conspicuous; cephalic area rather broad; thoracic area wider slightly; posterior sinus rather shallow. Dorsal ribs not forked; all grooves on carapace distinct. Respiratory areas close to each other, not bordered by pigment.

Antennule and antenna much like in preceding species; anterior spine of second segment of antennule very stout and curved at tip, spine on basal segment of antenna moderately larger than that of *A. caecus*.

Two pairs of post-maxillary spines present. All spines somewhat stout and yellowish brown as in *A. scutiformis*. Suckers comparatively large and widely separated; pattern of chitinous ribs and number of segments much like in *A. caecus*. Outer spine of three spines on basal segment of maxillae extremely small. First leg furnished with flagellum with tip just reaching base of coxa. In three posterior pairs of legs, posterior margin of basis and distal portion of coxa fringed with plumose setae; coxa of last pair provided with plumose setae along whole posterior margin. Tips of all legs fall short of margin of carapace. Abdomen, 1/3.5 of body, shield-shaped, wider than long, with bluntly pointed

² Named in honour of Prof. Katsuzô Onoda of the Nara Women's Higher Normal School who collected the specimens.

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posterior lobes; anal sinus very shallow, 1/6 of abdomen in length, and triangular; caudal furcae basal.

Remarks:—The number of segments of chitinous ribs of sucker, the stout spines and the well-developed carapace show that this form is already mature. This new species may be differentiated from its allied species *A. caecus* in its smaller and pigmentless body, shallower posterior sinus, stouter spine on the basal segment of antenna, comparatively large and separated suckers, uncoloured margins of respiratory areas, as well as in the presence of setae on the postero-distal margin of coxa of the second and third legs and in the shape of abdomen.

EXPLANATION OF PLATE

- Fig. 1. *Argulus japonicus*, ventral view of a female, obtained in summer, 1935. $\times 13$.
- Fig. 2. " " three posterior legs of male, ventral view. $\times 18$.
- Fig. 3. *Argulus coregoni*, three posterior legs of male, dorsal view. $\times 20$.
- Fig. 4. *Argulus scutiformis*, ventral view of female. $\times 3$.
- Fig. 5. *Argulus caecus*, ventral view of female. $\times 3$.
- Fig. 6. *Argulus onodai*, n. sp. ventral view of female. $\times 8$.
- Fig. 7. " " antennule and antenna of female. $\times 60$.

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TAKASI TOKIOKA

PLATE 21

